Interactions between Monetary and Fiscal Policy in the Euro Area

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This paper studies the interactions between monetary and fiscal policies in the euro area. It carefully discusses the process of policy competition and the structure of policy cooperation. As to policy competition, the focus is on competition between the European central bank, the American central bank, the German government, and the French government. As to policy cooperation, the focus is on the same institutions. These are higher-dimensional issues. The policy targets are price stability and full employment. Special features of this paper are numerical simulations of policy competition and numerical solutions to policy cooperation.

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Abstract

This paper studies the interactions between monetary and fiscal policies in the euro area. It carefully discusses the process of policy competition and the structure of policy cooperation. As to policy competition, the focus is on competition between the European central bank, the American central bank, the German government, and the French government. As to policy cooperation, the focus is on the same institutions. These are higher-dimensional issues. The policy targets are price stability and full employment. Special features of this paper are numerical simulations of policy competition and numerical solutions to policy cooperation.

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1. Introduction

This paper studies the interactions between monetary and fiscal policies in the euro area. It carefully discusses the process of policy competition and the structure of policy cooperation. As to policy competition, the focus is on competition between the European central bank, the American central bank, the German government, and the French government. As to policy cooperation, the focus is on the same institutions. These are higher-dimensional issues. The policy targets are price stability and full employment. The policy makers follow cold-turkey or gradualist strategies. Monetary and fiscal policies have spillover effects. Special features of this paper are numerical simulations of policy competition and numerical solutions to policy cooperation.

The paper is organized as follows: Monetary competition between Europe and America – Monetary cooperation between Europe and America – Fiscal competition between Germany and France – Fiscal cooperation between Germany and France – Monetary and fiscal competition: Cold-turkey policies – Monetary and fiscal competition: Gradualist policies – Monetary and fiscal cooperation – Summary – Appendix: A basic model of a monetary union.

The seminal paper by Levin (1983) is a natural extension of the classic papers by Fleming and Mundell. It deals with stabilization policy in a jointly floating currency area. It turns out, however, that the joint float produces results for the individual countries within the currency area and for the area as a whole that in some cases differ sharply from those in the Fleming and Mundell papers. The most surprising finding is that a fiscal expansion by one of the countries in the currency area produces a contraction of economic activity in the other country. This beggar-my-neighbour effect can be so strong as to cause a decline in economic activity within the area as a whole.

Some recent books and papers on policy interactions in the euro area are R. Beetsma, X. Debrun (2004), M. Buti (2003), M. Buti, D. Franco (2005), X. Debrun (1999), A. Hughes Hallet, P. Mooslechner, M. Schuerz (2001), L. Lambertini, R. Rovelli (2004), L. Onorante (2004), M. Sidiropoulos, E. Spyromitros (2005), H. Uhlig (2003), B. van Aarle, H. Garretsen, F. Huart (2003), and J. von Hagen, S. Mundschenk (2002).

2. Monetary Competition between Europe and America

1) The static model. The world consists of two monetary regions, say Europe and America. The exchange rate between Europe and America is flexible. Europe in turn consists of two countries, say Germany and France. So Germany and France form a monetary union. There is international trade between Germany, France and America. German goods, French goods and American goods are imperfect substitutes for each other. German output is determined by the demand for German goods. French output is determined by the demand for French goods. And American output is determined by the demand for American goods. European money demand equals European money supply. And American money demand equals American money supply. There is perfect capital mobility between Germany, France and America. Thus the German interest rate, the French interest rate, and the American interest rate are equalized. The monetary regions are the same size and have the same behavioural functions. The union countries are the same size and have the same behavioural functions. Nominal wages and prices adjust slowly.

As a result, an increase in European money supply raises both German output and French output, to the same extent respectively. On the other hand, the increase in European money supply lowers American output. Here the rise in European output exceeds the fall in American output. Correspondingly, an increase in American money supply raises American output. On the other hand, it lowers both German output and French output, to the same extent respectively. Here the rise in American output exceeds the fall in European output.

In the numerical example, an increase in European money supply of 100 causes an increase in German output of 150, an increase in French output of equally 150, and a decline in American output of 100. Similarly, an increase in American money supply of 100 causes an increase in American output of 300, a decline in German output of 50, and a decline in French output of equally 50. That is to say, the internal effect of monetary policy is very large, and the external effect of monetary policy is large.

Now have a closer look at the process of adjustment. An increase in European money supply causes a depreciation of the euro, an appreciation of the dollar, and a decline in the world interest rate. The depreciation of the euro raises German

exports and French exports. The appreciation of the dollar lowers American exports. And the decline in the world interest rate raises German investment, French investment and American investment. The net effect is that German output and French output go up. However, American output goes down. This model is in the tradition of the Mundell-Fleming model and the Levin model, see Carlberg (2000) and the Appendix.

The static model can be represented by a system of three equations:

$$Y_1 = A_1 + 0.5\alpha M_{12} - 0.5\beta M_3 \tag{1}$$

$$Y_2 = A_2 + 0.5\alpha M_{12} - 0.5\beta M_3 \tag{2}$$

$$Y_3 = A_3 + \alpha M_3 - \beta M_{12} \tag{3}$$

Of course this is a reduced form. Y_1 denotes German output, Y_2 is French output, Y_3 is American output, M_{12} is European money supply, M_3 is American money supply, A_1 is some other factors bearing on German output, A_2 is some other factors bearing on French output, and A_3 is some other factors bearing on American output. α and β denote the monetary policy multipliers. Strictly speaking, α and β are positive coefficients with $\alpha > \beta$. The endogenous variables are German output, French output, and American output.

The static model can be compressed to a system of two equations:

$$Y_{12} = A_{12} + \alpha M_{12} - \beta M_3 \tag{4}$$

$$Y_3 = A_3 + \alpha M_3 - \beta M_{12} \tag{5}$$

Here we have $Y_{12} = Y_1 + Y_2$ and $A_{12} = A_1 + A_2$. Y_{12} denotes European output and A_{12} is some other factors bearing on European output. The endogenous variables are European output and American output.

2) The dynamic model. At the beginning there is unemployment in Germany, France and America. More precisely, unemployment in Germany exceeds unemployment in France. The primary target of the European central bank is price stability in Europe. The secondary target of the European central bank is high employment in Germany and France. The specific target of the European

central bank is that unemployment in Germany equals overemployment in France. In other words, deflation in Germany equals inflation in France. So there is price stability in Europe. In a sense, the specific target of the European central bank is full employment in Europe. The instrument of the European central bank is European money supply. The European central bank raises European money supply so as to close the output gap in Europe:

$$M_{12} - M_{12}^{-1} = \frac{\overline{Y}_{12} - Y_{12}}{\alpha} \tag{6}$$

Here is a list of the new symbols:

Y_{12}	European output this period
$\overline{Y}_{12}$	full-employment output in Europe
$\overline{Y}_{12} - Y_{12}$	output gap in Europe this period
M_{12}^{-1}	European money supply last period
M_{12}	European money supply this period
$M_{12} - M_{12}^{-1}$	increase in European money supply.

Here the endogenous variable is European money supply this period M_{12}.

The target of the American central bank is full employment in America. The instrument of the American central bank is American money supply. The American central bank raises American money supply so as to close the output gap in America:

$$M_3 - M_3^{-1} = \frac{\overline{Y}_3 - Y_3}{\alpha} \tag{7}$$

Here is a list of the new symbols:

Y_3	American output this period
$\overline{Y}_3$	full-employment output in America
$\overline{Y}_3 - Y_3$	output gap in America this period
M_3^{-1}	American money supply last period
M_3	American money supply this period
$M_3 - M_3^{-1}$	increase in American money supply.

Here the endogenous variable is American money supply this period M_3. We assume that the European central bank and the American central bank decide simultaneously and independently.

In addition there is an output lag:

$$Y_{12}^{+1} = A_{12} + \alpha M_{12} - \beta M_3 \tag{8}$$

$$Y_3^{+1} = A_3 + \alpha M_3 - \beta M_{12} \tag{9}$$

According to equation (8), European output next period is determined by European money supply this period as well as by American money supply this period. Here Y_{12}^{+1} denotes European output next period. According to equation (9), American output next period is determined by American money supply this period as well as by European money supply this period.

The steady state can be represented in terms of the initial output gap and the total increase in money supply. Taking differences in equations (4) and (5), the model of the steady state can be written as follows:

$$\Delta Y_{12} = \alpha \Delta M_{12} - \beta \Delta M_3 \tag{10}$$

$$\Delta Y_3 = \alpha \Delta M_3 - \beta \Delta M_{12} \tag{11}$$

Here ΔY_{12} is the initial output gap in Europe, ΔY_3 is the initial output gap in America, ΔM_{12} is the total increase in European money supply, and ΔM_3 is the total increase in American money supply. The endogenous variables are ΔM_{12} and ΔM_3. The stability condition is $\alpha > \beta$. This condition is fulfilled. As a result, the steady state of monetary competition is stable. In other words, the process of monetary competition leads to full employment in Europe and America.

3) A numerical example: The case of unemployment. Full-employment output in Germany is 1000, full-employment output in France is equally 1000, and full-employment output in America is 2000. Let initial output in Germany be 940, let initial output in France be 970, and let initial output in America be 1910. In each of the countries there is unemployment and hence deflation.

Step 1 refers to the policy response. First consider monetary policy in Europe. The specific target of the European central bank is full employment in Europe. The output gap in Europe is 90. The monetary policy multiplier in Europe is 3.

So what is needed in Europe is an increase in European money supply of 30. Second consider monetary policy in America. The specific target of the American central bank is full employment in America. The output gap in America is 90. The monetary policy multiplier in America is 3. So what is needed in America is an increase in American money supply of 30.

Step 2 refers to the output lag. The increase in European money supply of 30 causes an increase in German output of 45 and an increase in French output of equally 45. As a side effect, it causes a decline in American output of 30. The increase in American money supply of 30 causes an increase in American output of 90. As a side effect, it causes a decline in German output of 15 and a decline in French output of equally 15. The net effect is an increase in German output of 30, an increase in French output of equally 30, and an increase in American output of 60. As a consequence, German output goes from 940 to 970, French output goes from 970 to 1000, and American output goes from 1910 to 1970.

Step 3 refers to the policy response. The output gap in Europe is 30. The monetary policy multiplier in Europe is 3. So what is needed in Europe is an increase in European money supply of 10. The output gap in America is 30. The monetary policy multiplier in America is 3. So what is needed in America is an increase in American money supply of 10. Step 4 refers to the output lag. The net effect is an increase in German output of 10, an increase in French output of equally 10, and an increase in American output of 20. As a consequence, German output goes from 970 to 980, French output goes from 1000 to 1010, and American output goes from 1970 to 1990. This process repeats itself round by round. Table 1 presents a synopsis.

In the steady state, German output is 985, French output is 1015, and American output is 2000. In Germany there is unemployment and deflation. In France there is overemployment and inflation. In Europe there is full employment and price stability. And in America there is full employment and price stability too. As a result, the process of monetary competition leads to full employment in Europe and America. And what is more, it leads to price stability in Europe and America. However, the process of monetary competition does not lead to full employment in Germany and France. And what is more, it does not lead to price stability in Germany and France.

4) A numerical example: The case of inflation. Let initial output in Germany be 1060, let initial output in France be 1030, and let initial output in America be 2090. In each of the countries there is overemployment and hence inflation. Step 1 refers to the policy response. The specific target of the European central bank is price stability in Europe. So what is needed in Europe is a reduction in European money supply of 30. The specific target of the American central bank is price stability in America. So what is needed in America is a reduction in American money supply of equally 30. Step 2 refers to the output lag. The net effect is a decline in German output of 30, a decline in French output of equally 30, and a decline in American output of 60. As a consequence, German output goes to 1030, French output goes to 1000, and American output goes to 2030.

In step 3, European money supply is lowered by 10, as is American money supply. In step 4, German output goes to 1020, French output goes to 990, and American output goes to 2010. And so on. In the steady state, German output is 1015, French output is 985, and American output is 2000. In Germany there is overemployment and inflation. In France there is unemployment and deflation. In Europe there is full employment and price stability. And in America there is full employment and price stability too.

3. Monetary Cooperation between Europe and America

1) The model. At the beginning there is unemployment in Germany, France and America. More precisely, unemployment in Germany exceeds unemployment in France. The targets of monetary cooperation are full employment in Europe and full employment in America. The instruments of monetary cooperation are European money supply and American money supply. So there are two targets and two instruments. As a result, there is a solution to monetary cooperation.

2) A numerical example. Let initial output in Germany be 940, let initial output in France be 970, and let initial output in America be 1910. In each of the countries there is unemployment and deflation. Step 1 refers to the policy response. The output gap in Europe is 90, as is the output gap in America. What is needed, then, is an increase in European money supply of 45 and an increase in American money supply of equally 45.

Step 2 refers to the output lag. The increase in European money supply of 45 raises German output and French output by 67.5 each. On the other hand, it lowers American output by 45. The increase in American money supply of 45 raises American output by 135. On the other hand, it lowers German output and French output by 22.5 each. The net effect is an increase in German output of 45, an increase in French output of equally 45, and an increase in American output of 90. As a consequence, German output goes from 940 to 985, French output goes from 970 to 1015, and American output goes from 1910 to 2000.

In Germany there is still some unemployment and deflation. In France there is now some overemployment and inflation. In Europe there is now full employment and price stability. And the same holds for America. As a result, monetary cooperation can achieve full employment in Europe and America. And what is more, it can achieve price stability in Europe and America. However, monetary cooperation cannot achieve full employment in Germany and France. And what is more, it cannot achieve price stability in Germany and France. Table 2 gives an overview.

4. Fiscal Competition between Germany and France

1) The static model. An increase in German government purchases raises German output. On the other hand, it lowers French output. And what is more, it raises American output. Here the rise in German output exceeds the fall in French output. And the rise in European output equals the rise in American output. Correspondingly, an increase in French government purchases raises French output. On the other hand, it lowers German output. And what is more, it raises American output. Here the rise in French output exceeds the fall in German output. And the rise in European output equals the rise in American output.

In the numerical example, an increase in German government purchases of 100 causes an increase in German output of 150, a decline in French output of 50, and an increase in American output of 100. Likewise, an increase in French government purchases of 100 causes an increase in French output of 150, a decline in German output of 50, and an increase in American output of 100.

Now have a closer look at the process of adjustment. An increase in German government purchases causes an appreciation of the euro, a depreciation of the dollar, and an increase in the world interest rate. The appreciation of the euro lowers German exports and French exports. The depreciation of the dollar raises American exports. And the increase in the world interest rate lowers German investment, French investment and American investment. The net effect is that German output moves up, French output moves down, and American output moves up. This model is in the tradition of the Mundell-Fleming model and the Levin model, see Carlberg (2000) and the Appendix.

The static model can be represented by a system of three equations:

$$Y_1 = A_1 + \gamma G_1 - \delta G_2 \qquad (1)$$

$$Y_2 = A_2 + \gamma G_2 - \delta G_1 \qquad (2)$$

$$Y_3 = A_3 + \varepsilon G_1 + \varepsilon G_2 \qquad (3)$$

Of course this is a reduced form. Y_1 denotes German output, Y_2 is French output, Y_3 is American output, G_1 is German government purchases, G_2 is French government purchases. γ, δ and ε denote the fiscal policy multipliers. Strictly speaking, γ, δ and ε are positive coefficients with $\gamma > \delta$ and $\varepsilon = \gamma - \delta$. The endogenous variables are German output, French output, and American output.

2) The dynamic model. At the beginning there is unemployment in both Germany and France. More precisely, unemployment in Germany exceeds unemployment in France. By contrast there is full employment in America. The target of the German government is full employment in Germany. The instrument of the German government is German government purchases. The German government raises German government purchases so as to close the output gap in Germany:

$$G_1 - G_1^{-1} = \frac{\overline{Y}_1 - Y_1}{\gamma} \qquad (4)$$

Here is a list of the new symbols:

Y_1 German output this period

$\overline{Y_1}$ full-employment output in Germany

$\overline{Y_1} - Y_1$ output gap in Germany this period

G_1^{-1} German government purchases last period

G_1 German government purchases this period

$G_1 - G_1^{-1}$ increase in German government purchases.

Here the endogenous variable is German government purchases this period G_1.

The target of the French government is full employment in France. The instrument of the French government is French government purchases. The French government raises French government purchases so as to close the output gap in France:

$$G_2 - G_2^{-1} = \frac{\overline{Y_2} - Y_2}{\gamma} \tag{5}$$

Here is a list of the new symbols:

Y_2 French output this period

$\overline{Y_2}$ full-employment output in France

$\overline{Y_2} - Y_2$ output gap in France this period

G_2^{-1} French government purchases last period

G_2 French government purchases this period

$G_2 - G_2^{-1}$ increase in French government purchases.

Here the endogenous variable is French government purchases this period G_2. We assume that the German government and the French government decide simultaneously and independently.

In addition there is an output lag:

$$Y_1^{+1} = A_1 + \gamma G_1 - \delta G_2 \tag{6}$$

$$Y_2^{+1} = A_2 + \gamma G_2 - \delta G_1 \tag{7}$$

$$Y_3^{+1} = A_3 + \varepsilon G_1 + \varepsilon G_2 \tag{8}$$

According to equation (6), German output next period is determined by German government purchases this period as well as by French government purchases this period. Here Y_1^{+1} denotes German output next period. According to equation (7), French output next period is determined by French government purchases

this period as well as by German government purchases this period. According to equation (8), American output next period is determined by German government purchases this period as well as by French government purchases this period.

The steady state can be represented in terms of the initial output gap and the total increase in government purchases. Taking differences in equations (1) and (2), the model of the steady state can be written as follows:

$$\Delta Y_1 = \gamma \Delta G_1 - \delta \Delta G_2 \qquad (9)$$

$$\Delta Y_2 = \gamma \Delta G_2 - \delta \Delta G_1 \qquad (10)$$

Here ΔY_1 is the initial output gap in Germany, ΔY_2 is the initial output gap in France, ΔG_1 is the total increase in German government purchases, and ΔG_2 is the total increase in French government purchases. The endogenous variables are ΔG_1 and ΔG_2. The stability condition is $\gamma > \delta$. This condition is fulfilled. As a result, the process of fiscal competition is stable. In other words, fiscal competition between Germany and France leads to full employment in Germany and France.

3) A numerical example. Full-employment output in Germany is 1000, full-employment output in France is equally 1000, and full-employment output in America is 2000. Let initial output in Germany be 940, let initial output in France be 970, and let initial output in America be 2000. In Germany there is unemployment and deflation. In France there is unemployment and deflation too. But in America there is full employment and price stability. Step 1 refers to the policy response. The output gap in Germany is 60. The fiscal policy multiplier in Germany is 1.5. So what is needed in Germany is an increase in German government purchases of 40. The output gap in France is 30. The fiscal policy multiplier in France is 1.5. So what is needed in France is an increase in French government purchases of 20.

Step 2 refers to the output lag. The increase in German government purchases of 40 causes an increase in German output of 60. As a side effect, it causes a decline in French output of 20 and an increase in American output of 40. The increase in French government purchases of 20 causes an increase in French output of 30. As a side effect, it causes a decline in German output of 10 and an

increase in American output of 20. The net effect is an increase in German output of 50, an increase in French output of 10, and an increase in American output of 60. As a consequence, German output goes from 940 to 990, French output goes from 970 to 980, and American output goes from 2000 to 2060.

Step 3 refers to the policy response. The output gap in Germany is 10. The fiscal policy multiplier in Germany is 1.5. So what is needed in Germany is an increase in German government purchases of 6.7. The output gap in France is 20. The fiscal policy multiplier in France is 1.5. So what is needed in France is an increase in French government purchases of 13.3. Step 4 refers to the output lag. The net effect is an increase in German output of 3.3, an increase in French output of 16.7, and an increase in American output of 20. As a consequence, German output goes from 990 to 993.3, French output goes from 980 to 996.7, and American output goes from 2060 to 2080. And so on. Table 3 presents a synopsis.

In the steady state, German output is 1000, French output is equally 1000, and American output is 2090. In Germany there is full employment and price stability. In France there is full employment and price stability too. But in America there is overemployment and inflation. As a result, fiscal competition between Germany and France leads to full employment in Germany and France. And what is more, it leads to price stability in Germany and France. However, as a severe side effect, it causes overemployment and inflation in America. Another severe side effect is an increase in European budget deficits.

5. Fiscal Cooperation between Germany and France

1) The model. At the beginning there is unemployment in both Germany and France. More precisely, unemployment in Germany exceeds unemployment in France. By contrast there is full employment in America. The targets of fiscal cooperation are full employment in Germany and full employment in France. The instruments of fiscal cooperation are German government purchases and French government purchases. So there are two targets and two instruments. As a result, there is a solution to fiscal cooperation.

2) A numerical example. Let initial output in Germany be 940, let initial output in France be 970, and let initial output in America be 2000. In Germany there is unemployment and deflation. In France there is unemployment and deflation too. But in America there is full employment and price stability. Step 1 refers to the policy response. The output gap in Germany is 60, and the output gap in France is 30. What is needed, then, is an increase in German government purchases of 52.5 and an increase in French government purchases of 37.5.

Step 2 refers to the output lag. The increase in German government purchases of 52.5 raises German output by 78.8 and lowers French output by 26.3. As a side effect, it raises American output by 52.5. The increase in French government purchases of 37.5 raises French output by 56.3 and lowers German output by 18.8. As a side effect, it raises American output by 37.5. The net effect is an increase in German output of 60, an increase in French output of 30, and an increase in American output of 90. As a consequence, German output goes from 940 to 1000, French output goes from 970 to 1000, and American output goes from 2000 to 2090.

In Germany there is now full employment and price stability. In France there is now full employment and price stability too. But in America there is now overemployment and inflation. As a result, fiscal cooperation between Germany and France can achieve full employment in Germany and France. And what is more, it can achieve price stability in Germany and France. However, as a severe side effect, it causes overemployment and inflation in America. Table 4 gives an overview.

6. Monetary and Fiscal Competition: Cold-Turkey Policies

1) The static model. This section deals with competition between the European central bank, the American central bank, the German government, and the French government. The static model can be represented by a system of three equations:

$$Y_1 = A_1 + 0.5\alpha M_{12} - 0.5\beta M_3 + \gamma G_1 - \delta G_2 \tag{1}$$

$$Y_2 = A_2 + 0.5\alpha M_{12} - 0.5\beta M_3 + \gamma G_2 - \delta G_1 \tag{2}$$

$$Y_3 = A_3 + \alpha M_3 - \beta M_{12} + \varepsilon G_1 + \varepsilon G_2 \qquad (3)$$

An increase in European money supply raises German output and French output but lowers American output. An increase in American money supply raises American output but lowers German output and French output. An increase in German government purchases raises German output. On the other hand, it lowers French output. And what is more, it raises American output. Correspondingly, an increase in French government purchases raises French output. On the other hand, it lowers German output. And what is more, it raises American output.

2) The dynamic model. At the beginning there is unemployment in Germany, France and America. More precisely, unemployment in Germany exceeds unemployment in France. The target of the European central bank is full employment in Europe. The instrument of the European central bank is European money supply. The target of the American central bank is full employment in America. The instrument of the American central bank is American money supply. The target of the German government is full employment in Germany. The instrument of the German government is German government purchases. The target of the French government is full employment in France. The instrument of the French government is French government purchases.

We assume that the central banks and the governments decide simultaneously and independently. In step 1, the European central bank, the American central bank, the German government, and the French government decide simultaneously and independently. In step 2, the European central bank, the American central bank, the German government, and the French government decide simultaneously and independently. And so on.

2) A numerical example. An increase in European money supply of 100 causes an increase in German output of 150, an increase in French output of equally 150, and a decline in American output of 100. An increase in American money supply of 100 causes an increase in American output of 300, a decline in German output of 50, and a decline in French output of equally 50. An increase in German government purchases of 100 causes an increase in German output of 150, a decline in French output of 50, and an increase in American output of 100.

Correspondingly, an increase in French government purchases of 100 causes an increase in French output of 150, a decline in German output of 50, and an increase in American output of 100. Further, full-employment output in Germany is 1000, full-employment output in France is equally 1000, and full-employment output in America is 2000.

Let initial output in Germany be 940, let initial output in France be 970, and let initial output in America be 1910. In each of the countries there is unemployment and deflation. Step 1 refers to the policy response. First consider monetary policy in Europe. The output gap in Europe is 90. The monetary policy multiplier in Europe is 3. So what is needed in Europe is an increase in European money supply of 30. Second consider monetary policy in America. The output gap in America is 90. The monetary policy multiplier in America is 3. So what is needed in America is an increase in American money supply of 30. Third consider fiscal policy in Germany. The output gap in Germany is 60. The fiscal policy multiplier in Germany is 1.5. So what is needed in Germany is an increase in German government purchases of 40. Fourth consider fiscal policy in France. The output gap in France is 30. The fiscal policy multiplier in France is 1.5. So what is needed in France is an increase in French government purchases of 20.

Step 2 refers to the output lag. The increase in European money supply of 30 causes an increase in German output of 45 and an increase in French output of equally 45. As a side effect, it causes a decline in American output of 30. The increase in American money supply of 30 causes an increase in American output of 90. As a side effect, it causes a decline in German output of 15 and a decline in French output of equally 15. The increase in German government purchases of 40 causes an increase in German output of 60. As a side effect, it causes a decline in French output of 20 and an increase in American output of 40. The increase in French government purchases of 20 causes an increase in French output of 30. As a side effect, it causes a decline in German output of 10 and an increase in American output of 20. The net effect is an increase in German output of 80, an increase in French output of 40, and an increase in American output of 120. As a consequence, German output goes from 940 to 1020, French output goes from 970 to 1010, and American output goes from 1910 to 2030.

Step 3 refers to the policy response. First consider monetary policy in Europe. The inflationary gap in Europe is 30. The monetary policy multiplier in Europe is

3. So what is needed in Europe is a reduction in European money supply of 10. Second consider monetary policy in America. The inflationary gap in America is 30. The monetary policy multiplier in America is 3. So what is needed in America is a reduction in American money supply of 10. Third consider fiscal policy in Germany. The inflationary gap in Germany is 20. The fiscal policy multiplier in Germany is 1.5. So what is needed in Germany is a reduction in German government purchases of 13.3. Fourth consider fiscal policy in France. The inflationary gap in France is 10. The fiscal policy multiplier in France is 1.5. So what is needed in France is a reduction in French government purchases of 6.7.

Step 4 refers to the output lag. The net effect is a decline in German output of 26.7, a decline in French output of 13.3, and a decline in American output of 40. As a consequence, German output goes from 1020 to 993.3, French output goes from 1010 to 996.7, and American output goes from 2030 to 1990. And so on. Table 5 presents a synopsis.

In the steady state, German output is 1000, French output is equally 1000, and American output is 2000. In each of the countries there is full employment and price stability. As a result, the process of monetary and fiscal competition leads to full employment in Germany, France and America. And what is more, it leads to price stability there.

What are the dynamic characteristics of this process? There are damped oscillations in money supply, government purchases and output. The German economy oscillates between unemployment and overemployment, as does the French economy and the American economy. Taking the sum over all periods, the total increase in European money supply is 22.5, the total increase in American money supply is equally 22.5, the total increase in German government purchases is 30, and the total increase in French government purchases is 15. Generally speaking, the total increase in European money supply depends on the initial output gap in Germany, the initial output gap in France, the initial output gap in America, the direct policy multipliers, and the cross policy multipliers. And the same holds for the total increase in American money supply, the total increase in German government purchases, and the total increase in French government purchases.

7. Monetary and Fiscal Competition: Gradualist Policies

At the start there is unemployment in Germany, France and America. More precisely, unemployment in Germany exceeds unemployment in France. The general target of the European central bank is full employment in Europe. We assume that the European central bank follows a gradualist strategy. The specific target of the European central bank is to close the output gap in Europe by 80 percent. The general target of the American central bank is full employment in America. We assume that the American central bank follows a gradualist strategy. The specific target of the American central bank is to close the output gap in America by 80 percent.

The general target of the German government is full employment in Germany. We assume that the German government follows a gradualist strategy. The specific target of the German government is to close the output gap in Germany by 20 percent. The general target of the French government is full employment in France. We assume that the French government follows a gradualist strategy. The specific target of the French government is to close the output gap in France by 20 percent.

We assume that the central banks and the governments decide simultaneously and independently. In step 1, the European central bank, the American central bank, the German government, and the French government decide simultaneously and independently. In step 2, the European central bank, the American central bank, the German government, and the French government decide simultaneously and independently. And so on.

As a result, the process of monetary and fiscal competition leads to full employment in Germany, France and America. And what is more, it leads to price stability in Germany, France and America. Let initial output in Germany be 940, let initial output in France be 970, and let initial output in America be 1910. Then, taking the sum over all periods, the total increase in European money supply is 36, the total increase in American money supply is equally 36, the total increase in German government purchases is 16.5, and the total increase in French government purchases is 1.5.

Now compare gradualist policies with cold-turkey policies. Under cold-turkey policies, there is a small increase in money supply and a large increase in government purchases. Under gradualist policies, conversely, there is a large increase in money supply and a small increase in government purchases. Of course, this depends on the relative speed of adjustment in money supply and government purchases. Judging from this point of view, gradualist policies seem to be superior to cold-turkey policies.

8. Monetary and Fiscal Cooperation

1) The model. This section deals with cooperation between the European central bank, the American central bank, the German government, and the French government. At the beginning there is unemployment in Germany, France and America. More precisely, unemployment in Germany exceeds unemployment in France. The targets of policy cooperation are full employment in Germany, full employment in France, and full employment in America. The instruments of policy cooperation are European money supply, American money supply, German government purchases, and French government purchases. There are three targets and four instruments, so there is one degree of freedom. As a result, there is an infinite number of solutions. In other words, monetary and fiscal cooperation can achieve full employment in Germany, France and America.

The policy model can be characterized by a system of three equations:

$$\Delta Y_1 = 0.5\alpha\Delta M_{12} - 0.5\beta\Delta M_3 + \gamma\Delta G_1 - \delta\Delta G_2 \tag{1}$$

$$\Delta Y_2 = 0.5\alpha\Delta M_{12} - 0.5\beta\Delta M_3 + \gamma\Delta G_2 - \delta\Delta G_1 \tag{2}$$

$$\Delta Y_3 = \alpha\Delta M_3 - \beta\Delta M_{12} + \varepsilon\Delta G_1 + \varepsilon\Delta G_2 \tag{3}$$

Here ΔY_1 denotes the initial output gap in Germany, ΔY_2 is the initial output gap in France, ΔY_3 is the initial output gap in America, ΔM_{12} is the required increase in European money supply, ΔM_3 is the required increase in American money supply, ΔG_1 is the required increase in German government purchases, and ΔG_2 is the required increase in French government purchases. The endogenous variables are ΔM_{12}, ΔM_3, ΔG_1 and ΔG_2.

We now introduce a fourth target. We assume that the increase in German government purchases should be equal in size to the reduction in French government purchases:

$$\Delta G_1 + \Delta G_2 = 0 \tag{4}$$

Put another way, we assume that the sum total of European government purchases should be constant. Add up equations (1) and (2), taking account of equation (4), to find out:

$$\Delta Y_1 + \Delta Y_2 = \alpha \Delta M_{12} - \beta \Delta M_3 \tag{5}$$

To simplify notation we introduce $\Delta Y_{12} = \Delta Y_1 + \Delta Y_2$, where ΔY_{12} is the initial output gap in Europe. This yields:

$$\Delta Y_{12} = \alpha \Delta M_{12} - \beta \Delta M_3 \tag{6}$$

Taking account of equation (4), equation (3) can be written as follows:

$$\Delta Y_3 = \alpha \Delta M_3 - \beta \Delta M_{12} \tag{7}$$

Then solve equations (6) and (7) for:

$$\Delta M_{12} = \frac{\alpha \Delta Y_{12} + \beta \Delta Y_3}{\alpha^2 - \beta^2} \tag{8}$$

$$\Delta M_3 = \frac{\alpha \Delta Y_3 + \beta \Delta Y_{12}}{\alpha^2 - \beta^2} \tag{9}$$

Further subtract equation (2) from equation (1) to find out:

$$\Delta Y_1 - \Delta Y_2 = (\gamma + \delta)(\Delta G_1 - \Delta G_2) \tag{10}$$

Then solve equations (4) and (10) for:

$$\Delta G_1 = \frac{\Delta Y_1 - \Delta Y_2}{2(\gamma + \delta)} \tag{11}$$

$$\Delta G_2 = \frac{\Delta Y_2 - \Delta Y_1}{2(\gamma + \delta)} \tag{12}$$

2) A numerical example. Let initial output in Germany be 940, let initial output in France be 970, and let initial output in America be 1910. In each of the countries there is unemployment and deflation. Step 1 refers to the policy response. The output gap in Germany is 60, the output gap in France is 30, the output gap in Europe is 90, and the output gap in America is equally 90. So what is needed, according to equations (8), (9), (11) and (12), is an increase in European money supply of 45, an increase in American money supply of equally 45, an increase in German government purchases of 7.5, and a reduction in French government purchases of equally 7.5.

Step 2 refers to the output lag. The increase in European money supply of 45 raises German output and French output by 67.5 each. On the other hand, it lowers American output by 45. The increase in American money supply of 45 raises American output by 135. On the other hand, it lowers German output and French output by 22.5 each. The increase in German government purchases of 7.5 raises German output by 11.3. On the other hand, it lowers French output by 3.8. And what is more, it raises American output by 7.5. The reduction in French government purchases of 7.5 lowers French output by 11.3. On the other hand, it raises German output by 3.8. And what is more, it lowers American output by 7.5. The net effect is an increase in German output of 60, an increase in French output of 30, and an increase in American output of 90. As a consequence, German output goes from 940 to 1000, French output goes from 970 to 1000, and American output goes from 1910 to 2000.

In each of the countries there is now full employment and price stability. As a result, monetary and fiscal cooperation can achieve full employment in Germany, France and America. Over and above that, it can achieve price stability in Germany, France and America. Table 6 gives an overview.

Finally compare policy cooperation with policy competition. Under policy competition (cold-turkey policies), the total increase in European money supply is 22.5, the total increase in American money supply is equally 22.5, the total increase in German government purchases is 30, the total increase in French government purchases is 15, and the total increase in European government purchases is 45. That means, the solution to policy cooperation is different from the steady state of policy competition. Under policy competition, there is a small increase in money supply and a large increase in government purchases. Under policy cooperation, however, there is a large increase in money supply and a zero increase in government purchases. Judging from this perspective, policy cooperation seems to be superior to policy competition.

9. Summary

1) Monetary competition between Europe and America. As a result, the process of monetary competition leads to full employment in Europe and America. And what is more, it leads to price stability in Europe and America. However, the process of monetary competition does not lead to full employment in Germany and France. And what is more, it does not lead to price stability in Germany and France.

2) Monetary cooperation between Europe and America. As a result, monetary cooperation can achieve full employment in Europe and America. Over and above that, it can achieve price stability in Europe and America. However, monetary cooperation cannot achieve full employment in Germany and France. Over and above that, it cannot achieve price stability in Germany and France.

3) Fiscal competition between Germany and France. As a result, the process of fiscal competition leads to full employment in Germany and France. And what is more, it leads to price stability in Germany and France. However, as a severe side effect, it causes overemployment and inflation in America.

4) Fiscal cooperation between Germany and France. As a result, fiscal cooperation can achieve full employment in Germany and France. Over and above that, it can achieve price stability in Germany and France. However, as a severe side effect, it causes overemployment and inflation in America.

5) Competition between the European central bank, the American central bank, the German government, and the French government. As a result, the process of monetary and fiscal competition leads to full employment in Germany, France and America. And what is more, it leads to price stability in Germany, France and America. There are damped oscillations in money supply, government purchases and output. The total increase in European government purchases is medium size.

6) Cooperation between the European central bank, the American central bank, the German government, and the French government. As a result, monetary and fiscal cooperation can achieve full employment in Germany, France and America. Over and above that, it can achieve price stability in Germany, France and America.

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Appendix: A Basic Model of a Monetary Union

1) The market for German goods. The behavioural functions underlying the analysis are as follows:

$$C_1 = C_1(Y_1) \tag{1}$$

$$I_1 = I_1(r) \tag{2}$$

$$G_1 = \text{const} \tag{3}$$

$$X_{12} = X_{12}(Y_2) \tag{4}$$

$$X_{13} = X_{13}(e, Y_3) \tag{5}$$

$$Q_1 = Q_1(Y_1) \tag{6}$$

Equation (1) is the consumption function of Germany. It states that German consumption is an increasing function of German income. Here C_1 denotes German consumption, and Y_1 is German income. Equation (2) is the investment function of Germany. It states that German investment is a decreasing function of the world interest rate. I_1 denotes German investment, and r is the world interest rate. According to equation (3), the German government fixes its purchases of goods and services. G_1 denotes German government purchases. Equations (4) and (5) are the export functions of Germany. Equation (4) states that German exports to France are an increasing function of French income. X_{12} denotes German exports to France, and Y_2 is French income. Equation (5) states that German exports to America are an increasing function of the exchange rate and an increasing function of American income. X_{13} denotes German exports to America, and Y_3 is American income. The message of equation (5) is that a depreciation of the euro raises German exports to America. Equation (6) is the import function of Germany. It states that German imports are an increasing function of German income. Q_1 denotes German imports from France and America. German output is determined by the demand for German goods $Y_1 = C_1 + I_1 + G_1 + X_{12} + X_{13} - Q_1$. Taking account of the behavioural functions (1) to (6), we arrive at the goods market equation of Germany:

$$Y_1 = C_1(Y_1) + I_1(r) + G_1 + X_{12}(Y_2) + X_{13}(e, Y_3) - Q_1(Y_1) \tag{7}$$

2) The market for French goods. The behavioural functions are as follows:

$$C_2 = C_2(Y_2) \tag{8}$$

$$I_2 = I_2(r) \tag{9}$$

$$G_2 = \text{const} \tag{10}$$

$$X_{21} = X_{21}(Y_1) \tag{11}$$

$$X_{23} = X_{23}(e, Y_3) \tag{12}$$

$$Q_2 = Q_2(Y_2) \tag{13}$$

Equation (8) is the consumption function of France. It states that French consumption is an increasing function of French income. Here C_2 denotes French consumption. Equation (9) is the investment function of France. It states that French investment is a decreasing function of the world interest rate. I_2 denotes French investment. According to equation (10), the French government fixes its purchases of goods and services. G_2 denotes French government purchases. Equations (11) and (12) are the export functions of France. Equation (11) states that French exports to Germany are an increasing function of German income. X_{21} denotes French exports to Germany. Equation (12) states that French exports to America are an increasing function of the exchange rate and an increasing function of American income. X_{23} denotes French exports to America. The message of equation (12) is that a depreciation of the euro raises French exports to America. Equation (13) is the import function of France. It states that French imports are an increasing function of French income. Q_2 denotes French imports from Germany and America. French output is determined by the demand for French goods $Y_2 = C_2 + I_2 + G_2 + X_{21} + X_{23} - Q_2$. Upon substituting the behavioural functions (8) to (13), we reach the goods market equation of France:

$$Y_2 = C_2(Y_2) + I_2(r) + G_2 + X_{21}(Y_1) + X_{23}(e, Y_3) - Q_2(Y_2) \tag{14}$$

3) The market for American goods. The behavioural functions are as follows:

$$C_3 = C_3(Y_3) \tag{15}$$

$$I_3 = I_3(r) \tag{16}$$

$$G_3 = \text{const} \tag{17}$$

$$X_{31} = X_{31}(e, Y_1) \tag{18}$$

$$X_{32} = X_{32}(e, Y_2) \tag{19}$$

$$Q_3 = Q_3(Y_3) \tag{20}$$

Equation (15) is the consumption function of America. It states that American consumption is an increasing function of American income. Here C_3 denotes American consumption. Equation (16) is the investment function of America. It states that American investment is a decreasing function of the world interest rate. I_3 denotes American investment. According to equation (17), the American government fixes its purchases of goods and services. G_3 denotes American government purchases. Equations (18) and (19) are the export functions of America. Equation (18) states that American exports to Germany are a decreasing function of the exchange rate and an increasing function of German income. X_{31} denotes American exports to Germany. The message of equation (18) is that a depreciation of the dollar raises American exports to Germany. Equation (19) states that American exports to France are a decreasing function of the exchange rate and an increasing function of French income. X_{32} denotes American exports to France. The message of equation (19) is that a depreciation of the dollar raises American exports to France. Equation (20) is the import function of America. It states that American imports are an increasing function of American income. Q_3 denotes American imports from Germany and France. American output is determined by the demand for American goods $Y_3 = C_3 + I_3 + G_3 + X_{31} + X_{32} - Q_3$. Upon inserting the behavioural functions (15) to (20) we get to the goods market equation of America:

$$Y_3 = C_3(Y_3) + I_3(r) + G_3 + X_{31}(e, Y_1) + X_{32}(e, Y_2) - Q_3(Y_3) \tag{21}$$

4) The European money market. The behavioural functions are:

$$L_1 = L_1(r, Y_1) \tag{22}$$

$$L_2 = L_2(r, Y_2) \tag{23}$$

$$M_{12} = \text{const} \qquad (24)$$

Equation (22) is the money demand function of Germany. It states that German money demand is a decreasing function of the world interest rate and an increasing function of German income. L_1 denotes German money demand. Equation (23) is the money demand function of France. It states that French money demand is a decreasing function of the world interest rate and an increasing function of French income. L_2 denotes French money demand. Equation (24) is the money supply function of Europe. It states that the European central bank fixes European money supply. M_{12} denotes European money supply. European money demand is equal to European money supply $L_1 + L_2 = M_{12}$. Taking account of the behavioural functions (22) to (24), we arrive at the money market equation of Europe $L_1(r, Y_1) + L_2(r, Y_2) = M_{12}$.

5) The American money market. The behavioural functions are:

$$L_3 = L_3(r, Y_3) \qquad (25)$$

$$M_3 = \text{const} \qquad (26)$$

Equation (25) is the money demand function of America. It states that American money demand is a decreasing function of the world interest rate and an increasing function of American income. L_3 denotes American money demand. Equation (26) is the money supply function of America. It states that the American central bank fixes American money supply. M_3 denotes American money supply. American money demand is equal to American money supply $L_3 = M_3$. Upon substituting the behavioural functions (25) and (26), we reach the money market equation of America $L_3(r, Y_3) = M_3$.

Table 1

Monetary Competition between Europe and America

The Case of Unemployment

	Germany	France	America
Initial Output	940	970	1910
Δ Money Supply		30	30
Output	970	1000	1970
Δ Money Supply		10	10
Output	980	1010	1990
and so on	...	...	...
Steady-State Output	985	1015	2000

Table 2

Monetary Cooperation between Europe and America

The Case of Unemployment

	Germany	France	America
Initial Output	940	970	1910
Δ Money Supply		45	45
Output	985	1015	2000

Table 3

Fiscal Competition between Germany and France

	Germany	France	America
Initial Output	940	970	2000
Δ Government Purchases	40	20	
Output	990	980	2060
Δ Government Purchases	6.7	13.3	
Output	993.3	996.7	2080
and so on	...	...	...
Steady-State Output	1000	1000	2090

Table 4

Fiscal Cooperation between Germany and France

	Germany	France	America
Initial Output	940	970	2000
Δ Government Purchases	52.5	37.5	
Output	1000	1000	2090

Table 5
Monetary and Fiscal Competition
Cold-Turkey Policies

	Germany	France	America
Initial Output	940	970	1910
Δ Money Supply		30	30
Δ Government Purchases	40	20	
Output	1020	1010	2030
Δ Money Supply		− 10	− 10
Δ Government Purchases	− 13.3	− 6.7	
Output	993.3	996.7	1990
and so on	...	...	...
Steady-State Output	1000	1000	2000

Table 6
Monetary and Fiscal Cooperation

	Germany	France	America
Initial Output	940	970	1910
Δ Money Supply		45	45
Δ Government Purchases	7.5	− 7.5	
Output	1000	1000	2000

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